DIRECTORATE FOR MATHEMATICAL AND PHYSICAL SCIENCES (MPS)

$1,432,730,000
+$80,890,000 / 6.0%

MPS Funding

(Dollars in Millions)

	FY 2010 Omnibus Actual	FY 2010 ARRA Actual	FY 2010 Enacted/ Annualized FY 2011 CR	FY 2012 Request	Change Over FY 2010 Enacted Amount	Change Over FY 2010 Enacted Percent
Division of Astronomical Sciences (AST)	$246.53	-	$245.69	$249.12	$3.43	1.4%
Division of Chemistry (CHE)	233.68	15.70	233.73	258.07	24.34	10.4%
Division of Materials Research (DMR)	302.57	-	302.67	320.79	18.12	6.0%
Division of Mathematical Sciences (DMS)	244.92	-	241.38	260.43	19.05	7.9%
Division of Physics (PHY)	301.66	-	290.04	300.91	10.87	3.7%
Office of Multidisciplinary Activities (OMA)	38.58	-	38.33	43.41	5.08	13.3%
Total, MPS	**$1,367.95**	**$15.70**	**$1,351.84**	**$1,432.73**	**$80.89**	**6.0%**

Totals may not add due to rounding.

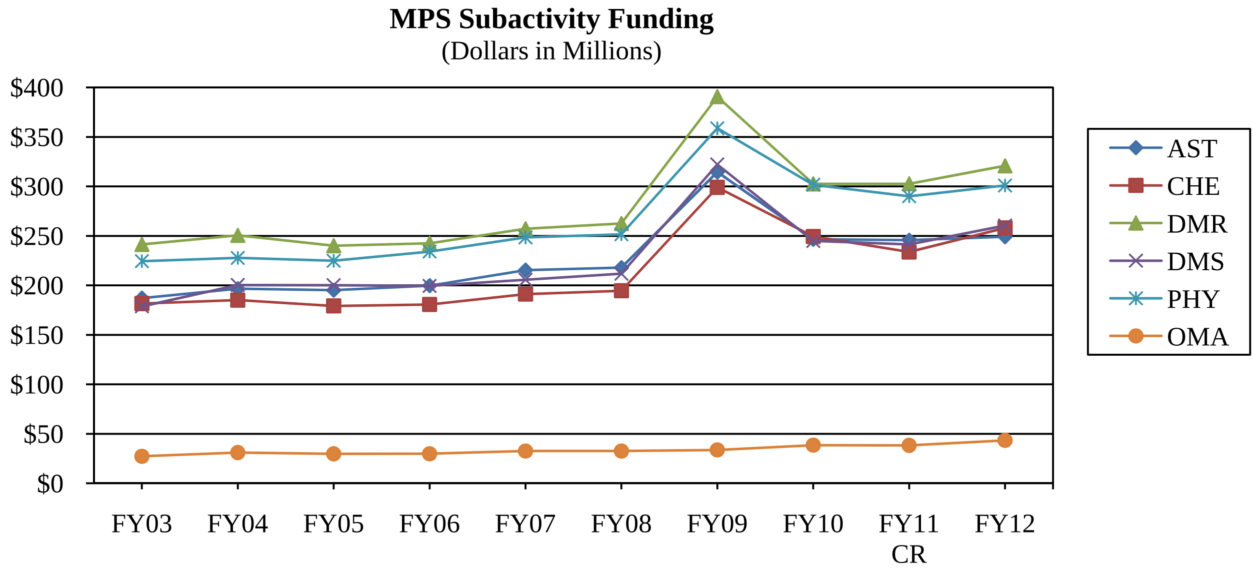
About MPS

The Directorate for Mathematical and Physical Sciences Request of $1,432.73 million is based on three key priorities: (1) strengthening innovation in basic research programs, (2) supporting essential facilities for basic science, and (3) providing significant funding for targeted basic research areas, including Cyberinfrastructure Framework for 21st Century Science and Engineering (CIF21); Science, Engineering, and Education for Sustainability (SEES); research at the interface between biological and mathematical and physical sciences (BioMaPS) and Science and Engineering Beyond Moore’s Law (SEMBL).

A principal driver of the FY 2012 Request is funding for core research programs; these awards drive new discoveries in the mathematical and physical sciences, directly strengthening the building blocks of innovation. The MPS commitment to core research strengthens science, seeds longer-term innovation, and develops the foundation for translational activities in NSF as well as other agencies, industry, and society.

MPS continues to fund the operations and management of 15 major multi-user facilities, allowing thousands of scientists and students to press the bounds of scientific knowledge, and invests in potential future projects needed to remain at the cutting-edge of research, such as the Large Synoptic Survey Telescope (LSST), which will rapidly scan the sky, charting objects that change or move and tracing billions of remote galaxies, providing multiple probes of the mysterious dark matter and dark energy.

MPS provides about 50 percent of the federal funding for basic research at academic institutions in the mathematical and physical sciences.



FY 2012 Summary by Division

- AST's FY 2012 Request is focused on ramping up the Atacama Large Millimeter Array (ALMA) to full operations as its construction funding comes to an end. This ramp will occur while AST continues to maintain its core grant programs in basic research and instrumentation development. The other highest priority activity will be continuing the design and development of the Large Synoptic Survey Telescope (LSST), the first-priority large project in the National Research Council decadal survey in astronomy and astrophysics, as LSST moves toward readiness for construction. AST will initiate funding for the NSF-wide investments in Enhancing Access to the Radio Spectrum (EARS) and Sustainable Energy Pathways (SEP), an element of SEES.

- CHE's FY 2012 Request is focused on enhancing support for core programs and, as part of the NSF-wide SEES investment, funding activities that will lay the foundation for future clean energy technologies and sustainable, environmentally benign chemical manufacturing. Funding for education and infrastructure programs in CHE will be reduced to accommodate these priorities.

- DMR plans to increase its portfolio of individual investigator awards, including NSF focus areas where advances in materials science are key: SEES, SEBML, and BioMaPS. DMR also plans to support the newly restructured Materials Research Centers and Teams Program as well as key facilities and to continue efforts to strengthen education in materials science and broaden participation in the discipline.

- DMS's FY 2012 Request is focused on enhancing support for basic research; training a diverse group of researchers in mathematical and statistical sciences, with better core, computational and communication skills; investing in mathematical sciences institutes and networking opportunities; and providing support and efficient mechanisms to foster multidisciplinary research activities in, but not limited to CIF21, SEES, and BioMaPS. Some of the limited existing funds from previous priority areas will also be invested to achieve these goals and be realigned to match division goals with that of MPS and NSF.

- PHY will focus on three major areas for FY 2012: providing continued support for individual investigator awards, especially in those areas that are priorities for the division, including physics of the universe, quantum information science, and the physics-biology interface; ensuring that sufficient funding is available for investigators using the major facilities sponsored by the division; and ensuring sufficient funding to support operations and maintenance of these facilities as they transition to a new era of operations. A major factor affecting total funding for PHY is the termination of NSF support for the Deep Underground Science and Engineering Laboratory (DUSEL), a savings of $36.0 million relative to FY 2010 Enacted. This $36.0 million will be repurposed within PHY to the three priority areas described above.

- OMA will continue its tradition of providing support for interdisciplinary research. In FY 2012, OMA will increase emphasis on key NSF-wide areas of SEES, CIF21, SEBML, BioMaPS, clean energy, and advanced manufacturing.

Major Investments

MPS Major Investments

(Dollars in Millions)

Area of Investment	FY 2010 Omnibus Actual	FY 2010 ARRA Actual	FY 2010 Enacted/ Annualized FY 2011 CR	FY 2012 Request	Change Over FY 2010 Enacted Amount	Change Over FY 2010 Enacted Percent
NNI	$199.11	-	$190.59	$182.36	-$8.23	-4.3%
SEES Portfolio	151.15	-	87.00	160.00	73.00	83.9%
CAREER	62.81	0.11	47.92	53.78	5.86	12.2%
SEBML	59.12	-	18.68	42.18	23.50	125.8%
BioMaPS	-	-	-	25.57	25.57	N/A
CIF21	-	-	-	20.00	20.00	N/A
Advanced Manufacturing	-	-	-	20.00	20.00	N/A
EARS	-	-	-	3.00	3.00	N/A

Major investments may have funding overlap and thus should not be summed.

- National Nanotechnology Initiative (NNI): MPS is a strong supporter of NNI, with $182.36 million in FY 2012. Although this represents a decrease from the FY 2010 level, MPS will invest both in basic NNI-related research and in the three FY 2012 NNI Signature Initiatives: Nanoelectronics for 2020 and Beyond, Nanomanufacturing for Sustainable Development, Nanotechnology for Solar Energy Collection and Conversion.. MPS NNI investments are primarily in fundamental science and in new materials, with significant support for education through the centers programs and for major facilities such as the National High Magnetic Field Laboratory and the National Nanotechnology Infrastructure Network.

- Science, Engineering, and Education for Sustainability Portfolio (SEES): MPS will continue to support the NSF-wide SEES investment by funding activities that will lay the foundation for future clean energy technologies and sustainable, environmentally benign chemical manufacturing. In FY 2012, MPS will invest in SEP and Sustainability Research Networks (SRN) including NSF-wide solicitations and programs as well as core research programs in SEES-related areas. In FY 2012, all five MPS Divisions and OMA will contribute to SEES-related activities at a level of $160.0 million.

- CAREER: At $53.78 million, MPS strongly supports CAREER, an Administration priority, providing nearly 25 percent of the total NSF investment. CAREER awards support young investigators who exemplify the role of teacher-scholars through outstanding research, excellent education and the integration of education and research within the context of the mission of their organizations.

- Science and Engineering Beyond Moore's Law (SEBML): In FY 2012, MPS will continue to invest in research designed to position the U.S. at the forefront of communications and computation capability. One area for investment in FY 2012 is $20.0 million requested for nanoelectronics research; MPS will partner in nanoelectronics with the Directorate for Computer and Information Science and Engineering (CISE), the Directorate for Engineering (ENG), and the Nanoelectronics Research Initiative (NRI), a consortium of companies in the Semiconductor Industry Association (SIA). MPS invested significantly more in SEBML research than originally expected in FY 2010 due to an increase in proposals in this area from the scientific community.

- Research at the Interface of Biological, Mathematical, and Physical Sciences (BioMaPS): MPS will invest in the BioMaPS program at $25.57 million, continuing the formal partnership with the Directorates for Biological Sciences (BIO) that began in FY 2010. In addition, ENG will join MPS and BIO in FY 2012 to support interdisciplinary research that will contribute to the NSF-wide efforts on clean energy and advanced manufacturing. The study of biological complexity necessitates new developments in mathematical and physical sciences, leading to new theoretical and experimental approaches. These interdisciplinary efforts will result in accelerated understanding of biological systems, as well as uncovering of new mathematical and physical concepts, leading to innovations in such areas as renewable fuels, bio-based materials, bio-imaging, and bio-inspired sensors. Working together, BIO, MPS, and ENG will coordinate research over the entire spectrum from the discovery of biological, physical, and mathematical principles underlying the biological processes, to their application to the energy sector and advanced manufacturing.

- Cyber-Infrastructure Framework for the 21st Century (CIF21): MPS will heavily support the new NSF-wide CIF21 investment in FY 2012 at $20.0 million. All Divisions in MPS will contribute to computational and data-enabled science and engineering activities, focusing on the areas of Data and New Computational Infrastructure. MPS will support fields necessary to ensure that simulations are able to capture the complexity of nature, and are physically correct, reproducible, and predictive, investing in MPS computational sciences, algorithm development, and software infrastructure needed for sustained long-term research efforts. Equal attention will be given to data-enabled science, including fundamental mathematical algorithms, software, data services, and network infrastructure needed to serve scientists wherever they are located.

- Advanced Manufacturing: MPS will fund this at $20.0 million. These investments will be made in the areas of nanomanufacturing, industry/university partnerships, and BioMaPS.

- Enhancing Access to the Radio Spectrum (EARS): Support of $3.0 million for EARS is initiated in FY 2012 to promote interdisciplinary research in use of the radio spectrum, in response to the Presidential Memorandum on “Unleashing the Wireless Broadband Revolution” and to the National Broadband Plan (http://www.broadband.gov). The recent NSF workshop report, *Enhancing Access to the Radio Spectrum*, outlines the need for research on new and innovative ways to use the spectrum more efficiently. In partnership with the Directorates for Engineering, Social, Behavioral, and Economic Sciences, and Computer and Information Sciences and Engineering, MPS will initiate support for the basic research that underpins this effort.

Summary and Funding Profile

MPS supports investment in core research and education as well as research infrastructure such as centers and facilities.

In FY 2012 MPS will spend $92.77 million for Centers, accounting for 6.5 percent of the MPS budget. This total is down from FY 2010 as a number of MPS-supported centers have sunsetted. Centers are an important modality for MPS sciences as research in many MPS-supported disciplines has evolved to be more collaborative and interdisciplinary. While two Science and Technology Centers are sunsetting in FY 2011, MPS is maintaining commitments to the Centers for Chemical Innovation and increasing its investments in Materials Centers.

Operations and maintenance funding for MPS-supported user facilities comprises 19 percent of MPS's FY 2012 Request. MPS has increased operations budgets for facilities to maintain current operational capacity. Where increases were not possible, MPS has maintained operations budgets as close to constant as possible.

MPS Funding Profile

	FY 2010 Actual Estimate	FY 2010 Enacted/ Annualized FY 2011 CR Estimate	FY 2012 Estimate
Statistics for Competitive Awards:			
Number of Proposals	9,421	8,500	9,500
Number of New Awards	2,680	2,150	2,350
Regular Appropriation	2,539	2,150	2,350
ARRA	141	-	-
Funding Rate	28%	25%	25%
Statistics for Research Grants:			
Number of Research Grant Proposals	7,688	7,200	8,500
Number of Research Grants	2,016	1,600	1,750
Regular Appropriation	2,016	1,600	1,750
ARRA	-	-	-
Funding Rate	26%	22%	21%
Median Annualized Award Size	$115,446	$115,000	$118,000
Average Annualized Award Size	$150,051	$140,000	$144,000
Average Award Duration, in years	3.1	3.1	3.1

MPS Funding for Centers Programs and Facilities

MPS Funding for Centers Programs

(Dollars in Millions)

	FY 2010 Omnibus Actual	FY 2010 Enacted/ Annualized FY 2011 CR	FY 2012 Request	Change Over FY 2010 Enacted Amount	Change Over FY 2010 Enacted Percent
Centers Programs	$100.99	$105.06	$92.77	-$12.29	-11.7%
Nanocenters	*13.70*	*13.56*	*7.57*	*-5.99*	*-44.2%*
STCs - 2002 Class	*6.60*	*6.60*	-	*-6.60*	*-100.0%*
STCs - 2006 Class	*4.00*	*4.00*	*4.00*	-	-
Centers for Analysis & Synthesis	*0.20*	*0.20*	*0.20*	-	-
Centers for Chemical Innovation	*24.00*	*24.00*	*24.00*	-	-
Materials Centers	*52.49*	*56.70*	*57.00*	*0.30*	*0.5%*

No FY 2010 obligations for centers were made with funds provided by the ARRA.

Detailed information on individual centers can be found in the NSF-Wide Investments chapter.

Centers Programs

- Nanocenters: MPS is reducing its commitment to the Nanoscale Science and Engineering Centers (NSEC) program (-$5.99 million to a total of $7.57 million) in FY 2012. The first class of NSECs, funded in 2001, received final year funding in FY 2010 and complete their research programs associated with this support in FY 2011. In FY 2012, funding for the formal NSEC program decreases as funds are reallocated to provide support that will transition the nano-devices created at graduating NSECs to a more applied level.

- Science and Technology Centers (STCs): Two MPS-supported Science and Technology Centers are sunsetting in FY 2011, the Center for Materials and Devices for Information Technology Research and the Center for Biophotonics Science and Technology. This results in a decrease of $6.60 million to a total of zero for the STC 2002 Class. MPS is maintaining its investment in the Center for Layered Polymeric Systems, initiated in FY 2006.

- Materials Centers: The Materials Research Science and Engineering Centers (MRSEC) program has been restructured in response to the 2007 National Academy of Science report *The NSF's Materials Research Science and Engineering Program, Looking Back, Moving Forward*. The new Materials Research Centers and Teams program has two tracks: Centers of Excellence for Materials Research and Innovation (CEMRI) and Materials Interdisciplinary Research Teams (MIRT). Competitions for both programs are held triennially, the first of which is expected in late FY 2011. FY 2012 Request funding in the table above (+$300,000 to a total of $57.0 million) provides new support for the CEMRI centers and ongoing support for the existing 14 MRSEC centers, which are expected to continue through FY 2014 as the old structure is phased out. Funding for the MIRT teams, $6.0 million, is captured in core programs, as presented in the DMR section.

MPS Funding for Facilities

(Dollars in Millions)

	FY 2010 Omnibus Actual	FY 2010 ARRA Actual	FY 2010 Enacted/ Annualized FY 2011 CR	FY 2012 Request	Change Over FY 2010 Enacted Amount	Change Over FY 2010 Enacted Percent
Facilities	$270.05	$15.00	$259.80	$268.77	$8.97	3.5%
Advanced Technology Solar Telescope (ATST)	-	-	-	*2.00*	*2.00*	*N/A*
Atacama Large Millimeter Array (ALMA)	*18.20*	-	*17.57*	*30.65*	*13.08*	*74.4%*
Cornell High Energy Synchr. Source (CHESS)	*9.51*	-	*9.00*	*15.47*	*6.47*	*71.9%*
GEMINI Observatory	*19.10*	-	*19.10*	*20.07*	*0.97*	*5.1%*
IceCube Neutrino Observatory (IceCube)	*2.15*	-	*2.15*	*3.45*	*1.30*	*60.5%*
Large Hadron Collider (LHC)	*18.00*	-	*18.00*	*18.00*	-	-
Laser Interfer. Grav. Wave Observatory (LIGO)	*28.50*	-	*28.50*	*30.40*	*1.90*	*6.7%*
Nat'l Astronomy & Ionosphere Center (NAIC)	*8.40*	-	*8.40*	*5.50*	*-2.90*	*-34.5%*
Nat'l High Magnetic Field Laboratory (NHFML)	*40.53*	*15.00*	*35.56*	*33.30*	*-2.26*	*-6.4%*
Nat'l Nanotechnology Infra. Network (NNIN)	*3.71*	-	*3.38*	*2.68*	*-0.70*	*-20.7%*
Nat'l Optical Astronomy Observatory (NOAO)	*35.40*	-	*31.50*	*29.17*	*-2.33*	*-7.4%*
Nat'l Radio Astronomy Observatory (NRAO)	*49.52*	-	*49.52*	*42.89*	*-6.63*	*-13.4%*
National Solar Observatory (NSO)	*9.10*	-	*9.10*	*9.79*	*0.69*	*7.6%*
Nat'l Superconducting Cyclotron Lab (NSCL)	*21.00*	-	*21.00*	*21.50*	*0.50*	*2.4%*
Other MPS Facilities [1]	*6.93*	-	*7.02*	*3.90*	*-3.12*	*-44.4%*

[1] Other MPS Facilities: Synchrotron Radiation Center (SRC), Center for High Resolution Neutron Scattering (CHRNS), and CheMatCARS.

For detailed information on individual facilities, please see the Facilities chapter.

Facilities

MPS has increased operations and maintenance budgets for facilities to maintain current operational capacity. Where increases were not possible, MPS has maintained budgets as close to constant as possible. Notable items include:

- ATST facility construction is presented in the MREFC chapter. $2.0 million presented above is the FY 2012 Request to support cultural mitigation activities agreed to during the permit/compliance process.
- ALMA: Support (+$13.08 million to a total of $30.65 million) is consistent with a planned ramp-up of operations as this observatory comes on line and begins early science activities.
- CHESS: Funding (+$6.47 million to a total of $15.47 million) for the synchrotron light source will allow this facility to continue operation as well as support X-ray technology research and development. The CHESS user program supports work in cancer research, new materials for electronics, aircraft, biotechnology, batteries, fuel cells, solar cells and other energy applications.
- LIGO: Support increases (+$1.90 million to a total of $30.40 million) in accordance with the agreed-upon funding profile for operations during the Advanced LIGO construction project. (See the MREFC chapter for more details on Advanced LIGO).
- NAIC: Decreased MPS funding for the Arecibo radio telescope (-$2.90 million to a total of $5.50 million) was recommended by the 2006 Senior Review of AST-supported facilities and programs. As a result of a solicitation in 2010, a new cooperative agreement with sufficient funding to preserve a

viable base facility is expected to be issued in FY 2012. (The Directorate for Geosciences also supports NAIC. See the Facilities chapter for more information).

- NHFML: Funding (-$2.26 million to a total of $33.30 million) will enable this world-leading laboratory to continue transformational research using high magnetic fields. This facility serves researchers in fields ranging from biology to materials and condensed matter physics. Note that the apparent decrease in the FY 2012 Request from the FY 2010 Actual is due to a one-time supplementary award in FY 2010 provided by the American Recovery and Reinvestment Act of 2009 for development of an instrument.
- NOAO: Support is eliminated for the Telescope System Instrumentation Program (TSIP), which funds community access to private telescopes. Future TSIP-like access may be acquired as part of other AST grants programs.
- NRAO: A decrease (-$6.63 million to a total of $42.89 million) is due to completion of the Expanded Very Large Array construction program.
- Other MPS Facilities: The major change (-$2.87 million) in this category is for NSF stewardship of the Wisconsin Synchrotron Research Center, which is being ended as planned in March 2011.

Pre-construction Planning:

- Deep Underground Science and Engineering Laboratory (DUSEL): NSF support for this proposed project is eliminated in FY 2012 (-$36.0 million), following the determination by the National Science Board that the scope and likely cost of the project were outside of NSF's core mission responsibilities. The Department of Energy will support pre-construction activities for its proposed Long Baseline Neutrino Experiment (LBNE), including an analysis of whether the LBNE far detector should be located at the Homestake site in South Dakota.
- Large Synoptic Survey Telescope (LSST): Funding for design and development activities is increased (+$1.0 million to $5.0 million) following the proposed project’s first-place ranking in the National Research Council’s Astronomy and Astrophysics Decadal Survey – *New Worlds, New Horizons in Astronomy and Astrophysics.*

Program Evaluation and Performance Improvement

The Performance Information chapter provides details regarding the periodic reviews of programs and portfolios of programs by external Committees of Visitors and directorate Advisory Committees. Please see this chapter for additional information.

Committees of Visitors (COV):

- In FY 2010, both CHE and DMS held their COV reviews. Both Divisions are responding to and implementing recommendations from their respective COV.
- In FY 2011, COV reviews will take place for AST and DMR.
- In FY 2012, a COV is planned to take place in PHY.

Reports by the National Research Council:

- A report released by the National Research Council in October 2009: *Evaluation of NSF’s Program of Grants and Vertical Integration of Research and Education in the Mathematical Sciences (VIGRE).* While the overall recommendation of the report was to continue the program, the two most recent competitions had yielded only a very small number of proposals.
- Late in FY 2010, the decadal survey in Astronomy and Astrophysics, *New Worlds, New Horizons,* was released by the National Research Council. Report recommendations are under review by AST,

and the first-ranked large project, the Large Synoptic Survey Telescope (LSST), has been given priority.

Science and Technology Policy Institute (STPI) Reports and Evaluations:

- In FY 2010, CHE supported a contract to the Science and Technology Policy Institute (STPI) to design the program evaluation for the Centers for Chemical Innovation CCI program. The design is complete for CCI Phase II and currently underway for CCI Phase I.
- In FY 2010, DMS initiated a STPI study to assess the need for and feasibility of evaluation of the mathematical sciences institutes *at the portfolio level*. If the formal evaluation is determined to be warranted and feasible, an additional objective is to recommend an evaluation approach and strategy. Final results from this study are expected during FY 2011.
- In FY 2010, MPS initiated a STPI feasibility study on MPS programs for broadening participation. The study will evaluate the appropriateness of an extensive analysis of the diverse ways in which the MPS directorate attempts to address the broadening participation of groups that have been traditionally underrepresented in the sciences. If the feasibility study shows such an analysis to be appropriate, MPS may follow up with an analysis and recommendation to contract for a thorough evaluation by a private sector contractor.

Number of People Involved in MPS Activities

	FY 2010 Actual Estimate	FY 2010 ARRA Estimate	FY 2010 Enacted/ Annualized FY 2011 CR Estimate	FY 2012 Estimate
Senior Researchers	9,153	78	7,639	8,100
Other Professionals	2,737	24	2,363	2,500
Postdoctorates	2,484	21	2,297	2,430
Graduate Students	8,774	48	8,042	8,520
Undergraduate Students	8,422	184	5,986	6,340
Total Number of People	**31,570**	**355**	**26,327**	**27,890**

DIVISION OF ASTRONOMICAL SCIENCES (AST) $249,120,000 +$3,430,000 / 1.4%

AST Funding

(Dollars in Millions)

	FY 2010 Omnibus Actual	FY 2010 Enacted/ Annualized FY 2011 CR	FY 2012 Request	Change Over FY 2010 Enacted	
				Amount	Percent
AST	**$246.53**	**$245.69**	**$249.12**	**$3.43**	**1.4%**
Research	**70.58**	**72.18**	**80.76**	**8.58**	**11.9%**
CAREER	*4.75*	*4.10*	*4.56*	*0.46*	*11.2%*
Education	**7.37**	**9.09**	**5.25**	**-3.84**	**-42.2%**
Infrastructure	**168.58**	**164.42**	**163.11**	**-1.31**	**-0.8%**
Gemini Observatory	*19.10*	*19.10*	*20.07*	*0.97*	*5.1%*
Atacama Large Mm Array(ALMA)	*18.20*	*17.57*	*30.65*	*13.08*	*74.4%*
Nat'l Astron. & Ion. Ctr. (NAIC)	*8.40*	*8.40*	*5.50*	*-2.90*	*-34.5%*
Nat'l Optical Astron. Obs (NOAO)	*35.40*	*31.50*	*29.17*	*-2.33*	*-7.4%*
Nat'l Radio Astron. Obs. (NRAO)	*49.52*	*49.52*	*42.89*	*-6.63*	*-13.4%*
Nat'l Solar Observatory (NSO)	*9.10*	*9.10*	*9.79*	*0.69*	*7.6%*
Pre-Construction Planning (total)	*9.06*	*12.00*	*5.00*	*-7.00*	*-58.3%*
Large Synoptic Survey Tel. (LSST)	*5.82*	*4.00*	*5.00*	*1.00*	*25.0%*
Giant Segmented Mirror Tel. (GSMT)	*0.24*	*5.00*	*-*	*-5.00*	*-100.0%*
Square Kilometer Array (SKA)	*3.00*	*3.00*	*-*	*-3.00*	*-100.0%*
Research Resources	*21.53*	*17.23*	*18.04*	*0.81*	*4.7%*

Totals may not add due to rounding.

AST is the federal steward for ground-based astronomy in the U.S., working in partnership with private institutions to enhance overall observing capacity and capability. Funding covers observational, theoretical, computational, and laboratory work to understand the origins and characteristics of planets, the Sun, other stars, our galaxy, extragalactic objects, and the structure and origin of the Universe through awards to individual investigators, small groups, and national facilities. AST supports the development of advanced technologies and instrumentation, the planning and design of future facilities, and management of the electromagnetic spectrum for scientific use. AST funds operations and maintenance for several national and international facilities. These major world-class facilities provide access to a wide range of observational resources on a competitive basis and serve thousands of users each year. (See the Facilities chapter of this document for more details). AST also funds various private facilities with varied arrangements for community access, as part of the ground-based public-private U.S. astronomy system.

In general, 18 percent of the AST portfolio is available for new research grants. The remaining 82 percent funds continuing awards made in previous years, including facility support at about 65 percent of the division’s budget.

FY 2012 Summary

All funding increases/decreases represent change over the FY 2010 Enacted level.

Research

- CAREER is supported at $4.56 million (+$460,000). This level maintains AST’s emphasis on supporting early career researchers and contributes to the Administration priority efforts.
- Investment of $2.0 million in Sustainable Energy Pathways in the SEES Portfolio supports the application of receptor and data-management systems for improved energy collection and efficiency.

- Support of $3.0 million for EARS is initiated in FY 2012 to promote interdisciplinary research in use of the radio spectrum, in response to the Presidential Memorandum on "Unleashing the Wireless Broadband Revolution" and to the National Broadband Plan (http://www.broadband.gov).
- Support for CIF21 is initiated in FY 2012. AST will contribute to this NSF-wide investment by supporting research into the analysis and archiving of large data sets and providing access to these large data sets to a broad cross-section of the scientific and public community. Of particular interest to AST is how data will be analyzed and served by the potential future LSST, which would have a data rate of tens of terabytes per day.

Education

The decrease in support for Education programs is chiefly due to these adjustments:

- The Astronomy and Astrophysics Postdoctoral Fellowship (AAPF) program is increased (+$200,000 to a total of $2.0 million). These fellowships require research and education components, so added funding will increase the emphasis on integrating research and education for early-career scientists.
- AST support for Integrative Graduate Education and Research Traineeship (IGERT) ends in FY 2012 (-$1.68 million) in order to reinvest in higher priority training programs within the division.
- GRF funding (-$300,000) is eliminated as the Research and Related Activities (R&RA) contribution to the program will be funded centrally through Integrative Activities (IA).
- The Partnerships in Astronomy and Astrophysics Research and Education (PAARE) program, aimed at increasing representation of under-represented minorities in astronomy, ends in FY 2012, (-$2.0 million). The demand for PAARE has been decreasing for several years; an evaluation will be conducted regarding future programs that may more effectively achieve similar goals.

Infrastructure

AST oversees an array of infrastructure projects and programs. For detailed information on individual AST facilities, please see the Facilities chapter.

- Gemini: FY 2012 support of $20.07 million for the Gemini Observatory reflects the agreement among the international partners for a 2.5 percent increase to account for the effects of inflation.
- ALMA: FY 2012 support (+$13.08 million to a total of $30.65 million) is consistent with a planned ramp-up of operations as this observatory comes on line and begins early science activities.
- NAIC: Funding for the Arecibo radio telescope decreases (-$2.90 million to a total of $5.50 million) as recommended by the 2006 Senior Review of AST-supported facilities and programs. As a result of a solicitation in 2010, a new cooperative agreement with sufficient funding to preserve a viable base facility is expected to be issued in FY 2012.
- NOAO: Support is eliminated for the TSIP program, which funds community access to private telescopes. Future TSIP-like access may be acquired as part of other AST grants programs.
- NRAO: A decrease (-$6.63 million to a total of $42.89 million) is due to completion of the Expanded Very Large Array construction program.
- NSO: Funding (+$690,0000 to $9.79 million total) supports continued operations and maintenance.
- LSST: Funding for design and development activities is increased (+$1.0 million to $5.0 million) following the proposed project's first-place ranking in the National Research Council's Astronomy and Astrophysics Decadal Survey – *New Worlds, New Horizons in Astronomy and Astrophysics (Astro2010).* Though still eligible for funding through AST instrumentation programs, lower ranked *Astro2010* candidates had their identified project funding reduced or eliminated.
- Research Resources: Funding growth (+$810,000 to a total of $18.04 million) due to higher programmatic demand. This includes the Advanced Technologies and Instrumentation and mid-scale experiment programs, which emphasize development of future instrumentation and use of university-scale instrumentation to address specific astrophysical questions.

DIVISION OF CHEMISTRY (CHE) $258,070,000
+$24,340,000 / 10.4%

CHE Funding

(Dollars in Millions)

	FY 2010 Omnibus Actual	FY 2010 ARRA Actual	FY 2010 Enacted/ Annualized FY 2011 CR	FY 2012 Request	Change Over FY 2011 Estimate Amount	Change Over FY 2011 Estimate Percent
CHE	**$233.68**	**$15.70**	**$233.73**	**$258.07**	**$24.34**	**10.4%**
Research	**206.28**	**0.70**	**206.03**	**247.72**	**41.69**	**20.2%**
CAREER	*21.05*	*0.11*	*20.80*	*22.67*	*1.87*	*9.0%*
Centers Funding (total)	*26.77*	-	*26.85*	*25.55*	*-1.30*	*-4.8%*
Centers for Chemical Innovation	*24.00*	-	*24.00*	*24.00*	-	-
Nanoscale Science & Engr. Centers	*2.77*	-	*2.85*	*1.55*	*-1.30*	*-45.6%*
Education	**11.99**	-	**12.30**	**6.95**	**-5.35**	**-43.5%**
ACC Postdoctoral Fellowships	*2.00*		*2.00*	-	*-2.00*	*-100.0%*
Infrastructure	**15.41**	**15.00**	**15.40**	**3.40**	**-12.00**	**-77.9%**
Nat'l Nanotech. Infra. Network (NNIN)	*0.40*	-	*0.40*	*0.40*	-	-
Nat'l High Magnetic Field Lab (NHMFL)	*4.03*	*15.00*	*4.06*	*1.50*	*-2.56*	*-63.1%*
Research Resources	*10.58*	-	*10.94*	*1.10*	*-9.84*	*-89.9%*

CHE supports a large and vibrant research community engaged in fundamental research linked to key national priorities. The basic research supported by CHE will enable the discovery of new catalysts for solar energy generation and storage, increased appreciation of and insight into the chemistry of life processes, new nanostructured materials that will revolutionize electronics, and better awareness of how nanosized aerosols and particles impact our environment. CHE supports research seeking paths to sustainable molecules and materials that are essential to our economy and well-being. In addition, CHE supports curiosity-driven research that leads to increased understanding of molecules and materials.

In general, 47 percent of the CHE portfolio is available for new research grants. The remaining 53 percent funds continuing grants made in previous years.

FY 2012 Summary

All funding decreases/increases represent change over the FY 2010 Enacted level.

Research

- An increase (+$40.94 million to a total of $195.54 million) for core research programs will enable greater support of projects at the frontier of chemistry.
- CAREER investment increases (+$1.87 million to a total of $22.67 million). This program is particularly important to the development of strong academic departments and the training of the next generation of scientists and engineers.
- The Centers for Chemical Innovations program, which inspires research on strategic, transformative "Grand Challenges" in chemical research, remains at $24.0 million. CCI awards are strengthened by direct links to chemical industry and governmental laboratories, which encourage successful transitions from the lab to innovation to societal applications. CHE plans to initiate three new Phase I CCIs and fund two Phase II CCIs. The Phase II awards will be selected competitively from a pool of four Phase I awards and one Phase II CCI requesting renewal.

- New and continuing investments in the areas below will be committed as research grants, centers, and software institutes.
  - SEES funding increases (+$23.50 million for a total of $63.50 million). New understanding of the chemistry of nanosized aerosols and dusts will impact the research of climate scientists and climate modelers. Increased understanding of photovoltaic and photocatalytic materials will lead to new possibilities for chemical fuels from sunlight, fuel cells and batteries. Chemists will develop the fundamental understanding, reactions, and catalysts that will allow a new sustainable chemical industry using bio-based feedstocks and inexpensive and inexhaustible building blocks such as water, carbon dioxide, and dinitrogen. Through interdisciplinary programs such as Sustainable Research Networks and Sustainable Energy Pathways, chemists will work with others to effectively translate the fundamental chemical advances into new energy systems.
  - Investment ($4.30 million) in advanced manufacturing will include new modes of funding that support industry-university interactions.
  - A new investment of $3.50 million in CIF21 will include efforts in data-enabled science and chemometrics, Matter by Design and other aspects of computational chemistry, and a significant investment in new software development.
  - Research at the chemistry-biology interface is rapidly expanding. CHE funding in BioMaPS ($5.24 million) will strengthen research programs in advanced spectroscopic and imaging techniques for biomolecules and biosystems, metal speciation, coordination and function, chemical studies of enzyme and ribozyme catalysis, and other studies at the chemistry-biology frontier. This funding includes emphases on research at this interface aimed at clean energy ($800,000) and advanced manufacturing ($800,000).
  - SEBML investment will increase (+$7.60 million to a total of $13.68 million). Emerging areas include molecular electronics, spintronics, and molecule-based quantum computing. This includes a contribution to the new nanoelectronics area of $3.0 million.

Education

- Support will slightly increase for IGERT (+$40,000 to a total of $1.58 million) and slightly decreases for REU Sites (-$550,000 to a total of $4.50 million).
- Support is suspended for the American Competitiveness in Chemistry Fellowship Program for FY 2012 (-$2.0 million to zero). These funds will be reallocated to core research programs. Postdoctoral researchers will continue to be supported through research grants and centers, as well as the new SEES Postdoctoral Fellowship program.
- The Undergraduate Research Collaborative was terminated as planned in FY 2011 (-$1.0 million).
- GRF funding (-$1.59 million) within CHE is eliminated as the Research and Related Activities (R&RA) contribution to the program will be funded centrally through Integrative Activities (IA).

Infrastructure

- NNIN: Co-funding support continues at $400,000.
- NHMFL: Co-funding support continues at $1.50 million. The decrease of -$2.56 million is due to a one-time instrument development award funded in FY 2010.
- Research Resources: The Chemistry Research Instrumentation and Facilities: Departmental Multiuser Instrumentation (CRIF:MU) program will be suspended in FY 2012 (-$9.84 million to a total of $1.10 million). The funds will be reallocated to core research programs. The investigator community will be encouraged to use the Major Research Instrumentation (MRI) program for infrastructure needs in FY 2012. (See the Integrative Activities section for more information on MRI).

DIVISION OF MATERIALS RESEARCH (DMR) $320,790,000
+$18,120,000 / 6.0%

DMR Funding

(Dollars in Millions)

	FY 2010 Omnibus Actual	FY 2010 Enacted/ Annualized FY 2011 CR	FY 2012 Request	Change Over FY 2010 Enacted Amount	Change Over FY 2010 Enacted Percent
DMR	**$302.57**	**$302.67**	**$320.79**	**$18.12**	**6.0%**
Research	**224.27**	**225.26**	**254.14**	**28.88**	**12.8%**
CAREER	*20.20*	*14.19*	*15.59*	*1.40*	*9.9%*
Centers Funding (total)	*67.97*	*72.33*	*65.88*	*-6.45*	*-8.9%*
Materials Research Centers	*52.49*	*56.70*	*57.00*	*0.30*	*0.5%*
Nanoscale Science & Engr. Centers	*8.16*	*8.31*	*4.88*	*-3.43*	*-41.3%*
STC 2002: Materials and Devices for Inform. Tech.	*3.32*	*3.32*	-	*-3.32*	*-100.0%*
STC 2006: Center for Layered Polymeric Systems	*4.00*	*4.00*	*4.00*	-	-
Education	**11.72**	**9.48**	**9.00**	**-0.48**	**-5.1%**
Infrastructure	**66.58**	**67.93**	**57.65**	-10.28	-15.1%
Nat'l Nanotech. Infra. Network (NNIN)	*2.99*	*2.65*	*2.28*	*-0.37*	*-14.0%*
Nat'l High Magn.Field Lab (NHMFL)	*36.50*	*31.50*	*31.80*	*0.30*	*1.0%*
Cornell High Energy Synchr. (CHESS)	*9.51*	*9.00*	*15.47*	*6.47*	*71.9%*
Research Resources	*6.35*	*13.06*	-	*-13.06*	*-100.0%*
Other MPS Facilities [1]	*6.93*	*7.02*	*3.90*	*-3.12*	*-44.4%*

[1] Other MPS Facilities: Synchrotron Radiation Center, Center for High Resolution Neutron Scattering, and CheMatCars.

Awards from DMR cover a wide spectrum of materials research and education ranging from condensed matter and materials physics, solid-state and materials chemistry, multifunctional, hybrid, electronic, photonic, metallic, superconducting, ceramic, polymeric, biomaterials, composites, and nanostructures. These awards enable the DMR community to advance our understanding of electronic, atomic, molecular mechanisms and processes that govern macroscale properties so that we can learn how to manipulate and control them, to discover new synthesis and processing strategies that lead to new materials with unique and novel properties, and to discover and to understand emerging phenomena. The discoveries and advancements transcend traditional scientific and engineering disciplines, and can result in elimination of roadblocks to enabling new technology. A key and critical enabler to these scientific advances is the investment in development and support of next generation instruments and facilities. Finally, conveying the excitement, significance and societal benefit enabled by materials research to students (K-12 and beyond), some of whom will become the next generation of materials researchers, and to the general public remain important aspects of the Division's mission.

In general, 24 percent of the DMR portfolio is available for new research grants and 76 percent funds continuing grants.

FY 2012 Summary

All funding decreases/increases represent change over the FY 2010 Enacted level.

Research

- Funding for SEES increases (+$21.0 million to a total of $61.0 million). DMR's fundamental research in energy focuses on new phenomena that may transform energy production, storage, delivery and use in a decade or more. DMR plans to continue its partnerships with the Divisions of Chemistry and Mathematical Sciences on the SOLAR project and with the Directorate for Engineering on Nanotechnology for Solar Energy Collection and Conversion Signature Initiative.
- Funding for SEBML (+$10.70 million will total $17.55 million) will support discovery of new materials, devices, and processes such as nanoelectronics, photonics, spintronics, atom condensates, entanglement and superposition, and molecular-based approaches, any of which might become the next physical basis of computing. This includes a contribution of $3.0 million to the nanoelectronics investment area, a Signature Initiative.
- DMR will foster the underlying fundamental materials science that will enable breakthroughs in advanced manufacturing technologies ($3.80 million).
- The Matter-by-Design effort (+$3.50 million) will increase understanding and development of new matter from sub-components, ranging from biological and polymeric assemblies to metallic and ceramic nanostructures and hybrids. The advantage of this approach comes from the combination of experts who know how to envision new structures, to synthesize them to a sufficient level of purity, to discover their properties and characterize them, to predict new matter based on them, and to use data to design new materials.
- Biological aspects of materials research are the most rapidly growing component of materials research and will be supported at a level of $5.24 million in FY 2012 through the BioMaPS effort. Biomaterials can have important applications in medical devices, biosensors and actuators, tissue engineering, drug and gene delivery, nanomedicine, and medical imaging, benefitting health and ecosystems. This funding includes emphases on research at this interface aimed at clean energy ($800,000) and advanced manufacturing ($800,000).
- In keeping with the administration's goal of maintaining strong support for CAREER, funding will increase by $1.40 million to a total of $15.59 million.

Centers

- DMR increases its commitment to the newly restructured Materials Research Centers and Teams program as an interdisciplinary vehicle for increasing materials research, reaching new institutions, and educating students. The restructuring created two tracks: Centers for Materials Research and Innovation (CEMRI) and new and distinct Materials Interdisciplinary Research Teams (MIRT). FY 2011 marks the competition year, which is held triennially. In FY 2012, DMR will invest $57.0 million in the CEMRI centers as well as $6.0 million in the MIRT teams, whose funding is captured in the core research program budget line. The sum of these two areas, $63.0 million, is an increase of $6.30 million in FY 2012.
- Funding for the Nanoscale Science and Engineering Centers will continue at a reduced level (-$3.43 million for a total of $4.88 million) due to the planned sunsetting of some centers.
- Funding for the STCs (-$3.32 million to a total $4.0 million) reflects the planned sunsetting of the Class of 2002 Center for Materials and Devices for Information Technology. The Center for Layered Polymeric Systems, initiated in FY 2006, will be maintained at $4.0 million.

Education

- The Education portfolio maintains a commitment to Research Experiences for Undergraduates (REU) and the Integrative Graduate Education and Research Traineeship (IGERT) programs.
- GRF funding (-$500,000) is eliminated as the Research and Related Activities (R&RA) contribution to the program will be funded centrally through Integrative Activities (IA).

Infrastructure

- NHFML: Funding (+$300,000 to a total of $31.80 million) will enable this world-leading laboratory to continue transformational research using high magnetic fields. This facility serves researchers in fields ranging from biology to materials and condensed matter physics.
- CHESS: Funding (+$6.47 million to a total of $15.47 million) for the synchrotron light source, CHESS/CESR, will allow continued operation as well as support X-ray technology research and development. The CHESS user program supports work in cancer research, new materials for electronics, aircraft, biotechnology, batteries, fuel cells, solar cells and other energy applications.
- Other MPS Facilities: The major change (-$2.87 million) in this category is for NSF stewardship of the Wisconsin Synchrotron Research Center, which is being ended as planned in March 2011.
- Research Resources: The Instrumentation for Materials Research-Major Instrumentation Program and the Instrumentation for Materials Research Program will not be run in FY 2012 (-$13.06 million).

DIVISION OF MATHEMATICAL SCIENCES (DMS) $260,430,000

+$19,050,000 / 7.9%

DMS Funding

(Dollars in Millions)

	FY 2010 Omnibus Actual	FY 2010 Enacted/ Annualized FY 2011 CR	FY 2012 Request	Change Over FY 2010 Enacted Amount	Change Over FY 2010 Enacted Percent
DMS	**$244.92**	**$241.38**	**$260.43**	**$19.05**	**7.9%**
Research	**216.19**	**214.23**	**240.80**	**26.57**	**12.4%**
CAREER	*7.96*	*3.23*	*3.53*	*0.30*	*9.3%*
Centers for Analysis & Synthesis	*0.10*	*0.10*	*0.10*	-	-
Education	**28.73**	**27.15**	**19.63**	**-7.52**	**-27.7%**

NSF plays a critical role in the mathematical sciences, as it provides more than 60 percent of all federal support for basic research in the Nation’s colleges and universities. In certain core areas of the mathematical sciences this percentage is much higher, since NSF supports a broader range of fundamental and multidisciplinary research topics than do other federal agencies.

DMS supports research at the frontiers of fundamental, applied, and computational mathematics and statistics and also enables discovery and innovation in other fields of science and engineering. In turn, advances in science and engineering, especially those generating massive and complex data sets or that are driven by powerful computing environments, require development of ever more sophisticated mathematical and statistical tools. DMS plays a key role in training future researchers in the mathematical and statistical sciences, and in training the Nation’s scientific and engineering workforce.

DMS supports core research programs in algebra and number theory; analysis; applied mathematics; computational mathematics; geometry and topology; mathematical biology; probability, combinatorics and foundations; and various areas within statistics. In addition, DMS supports national mathematical sciences research institutes; training and mentoring of a diverse group of postdoctoral, graduate and undergraduate students; and infrastructure, such as workshops, conferences, and equipment.

In general, 59 percent of the DMS portfolio is available for new research grants. The remaining 41 percent is used primarily to fund continuing grants made in previous years. In FY 2010, DMS received 2,455 research proposals and made 715 awards.

FY 2012 Summary

All funding increases/decreases represent change over the FY 2010 Enacted level.

Research

- Support for CIF21 is initiated in FY 2012 at $6.60 million. DMS research will focus on mathematical, statistical, and computational sciences which will support theoretical and methodological developments in mathematics and statistics, the development of new models and algorithms, visualization methods and computational tools that help solve complex scientific problems involving massive and complex data, and that enable scientific discovery and innovation. This investment expands upon some existing programs supporting research in the analysis of large data sets, development of novel algorithms, and new computational methods in mathematics and statistics. It will also support training and networking activities, and help develop new theoretical foundations in mathematics and statistics related to CIF21 goals.

- SEES increases by +$14.50 million to a total of $21.50 million. This activity will address challenges in climate, sustainability, and energy research, and education through data analysis, modeling, and simulation. Also, DMS will increase investment in the CHE-DMR-DMS Solar Energy project (SOLAR), a program supporting multi-disciplinary teams engaged in research on the efficient harvesting, conversion, and storage of solar energy. The investment in SEES will also support effective training and networking opportunities for collaborations among mathematical scientists and with domain scientists.
- Support for advanced manufacturing activity will be $2.0 million. DMS seeks to invest in innovative partnerships between university and industry scientists in mathematical and statistical sciences, and support research in Materials by Design as it relates to computational, mathematical, and statistical sciences in CIF21.
- BioMaPS support will be initiated at $5.24 million. DMS will invest in innovative research at the intersection of the mathematical and physical sciences and the biological sciences in a comprehensive new approach to acquire insight into and inspiration from the living world. This funding includes emphases on research at this interface aimed at clean energy ($800,000) and advanced manufacturing ($800,000).
- SEBML funding increases by +$1.20 million to a total of $3.95 million. In parallel with Moore’s Law for hardware, SEBML continues the algorithmic “Moore’s Law”, i.e., the exponential increase in speed of basic computations due to innovative new algorithms, and develops new mathematical and statistical frameworks for computation.
- Support increases for mathematical sciences institutes (+$5.50 million to a total of $32.50 million). Institutes are typically funded on 10-year cycles and the current cycle for three of the Institutes ends in FY 2011. They are eligible to re-compete with other projects for funding in FY 2012. This budget growth will accommodate an increase in the number and/or size of Institute awards.
- Support will increase (+$4.0 million to a total of over $180.0 million) for individual investigator and small group awards in disciplinary research programs. This will be achieved by an effective consolidation of existing interdisciplinary partnerships.
- Consistent with the Administration’s priority, funding for CAREER will increase (+$300,000 to a total of $3.53 million).
- Funding for Cyber-Enabled Discovery and Innovation (CDI) will decrease (-$10.40 million to zero). DMS will more effectively fund highly interdisciplinary research where the mathematical sciences play a fundamental role by focusing on other specific interdisciplinary programs and partnerships.

Education

- Funding for Enhancing the Mathematical Sciences Workforce for the 21st Century (EMSW21) will decrease (-$5.26 million to $11.77 million). Higher priority programs in the overall DMS workforce portfolio more closely support research and training in the disciplinary programs.
- Interdisciplinary Training for Undergraduates in Biological and Mathematical Sciences (UBM) will end (-$1.0 million) and be merged into BioMaPS.
- Funding for IGERT ends in FY 2012 in order to reinvest these funds in higher priority training programs within the division.
- GRF funding (-$500,000) is eliminated as the Research and Related Activities (R&RA) contribution to the program will be funded centrally through Integrative Activities (IA).

DIVISION OF PHYSICS (PHY) $300,910,000 +$10,870,000 / 3.7%

PHY Funding

(Dollars in Millions)

	FY 2010 Omnibus Actual	FY 2010 Enacted/ Annualized FY 2011 CR	FY 2012 Request	Change Over FY 2010 Enacted Amount	Percent
PHY	**$301.66**	**$290.04**	**$300.91**	**$10.87**	**3.7%**
Research	**178.72**	**177.97**	**214.12**	**36.15**	**20.3%**
CAREER	*8.76*	*5.60*	*7.43*	*1.83*	*32.7%*
Centers Funding (total)	*5.68*	*5.68*	*1.14*	*-4.54*	*-79.9%*
STC 2002: Cntr. For Bio. Sci.&Tech.	*3.28*	*3.28*	-	*-3.28*	*-100.0%*
Nanoscale Sci. and Eng. Ctrs.	*2.40*	*2.40*	*1.14*	*-1.26*	*-52.5%*
Education	**8.14**	**9.42**	**8.44**	**-0.98**	**-10.4%**
Infrastructure	**114.80**	**102.65**	**78.35**	**-24.30**	**-23.7%**
Large Hadron Collider (LHC)	*18.00*	*18.00*	*18.00*	-	-
Laser Inteferomter Grav. Wave Obs. (LIGO)	*28.50*	*28.50*	*30.40*	*1.90*	*6.7%*
Nat'l Superconducting Cyclotron Lab (NSCL)	*21.00*	*21.00*	*21.50*	*0.50*	*2.4%*
IceCube	*2.15*	*2.15*	*3.45*	*1.30*	*60.5%*
Pre-Construction Planning (total)	*40.69*	*29.00*	-	*-29.00*	*-100.0%*
Deep Underground Sci. & Engr. Lab (DUSEL) [1]	*40.69*	*29.00*	-	*-29.00*	*-100.0%*
Research Resources	*4.47*	*5.00*	*5.00*	-	-

[1] DUSEL FY 2010 Actual includes $11.74 million in carryover funding from FY 2009.

The Division of Physics (PHY) supports fundamental research addressing frontier areas of physics that lead to the understanding of the make-up of the Universe, from the formation of stars and galaxies to the principles of life processes on earth. This research is spread across a range of subfields: atomic, molecular, optical and plasma physics; elementary particle physics; gravitational physics; nuclear physics; particle and nuclear astrophysics; physics of living systems; physics at the information frontier; and theoretical physics. PHY is the primary supporter of all U.S. research in gravitational physics and the leading supporter of fundamental research in atomic, molecular, and optical physics in the U.S. PHY is an important partner with the Department of Energy (DOE) in support of elementary particle physics, nuclear physics, and plasma physics. PHY also has the only U.S. program designed for the support of physics research in living systems. Development of advanced, cutting-edge computational resources, innovative technology, and new instrumentation is a key part of physics research, and tools developed by the physics community continuously have major impact in other scientific and engineering fields.

In general, 22 percent of the PHY portfolio is available for new research grants. The remaining 78 percent is used primarily to fund continuing grants made in previous years (53 percent) and to support operations and maintenance for four facilities that are a key part of the division portfolio (25 percent).

FY 2012 Summary

All funding decreases/increases represent change over the FY 2010 Enacted level.

Research

- An increase of $36.15 million to a total of $214.12 million for research grants will enable increased support of projects at the discovery frontiers of physics. Major changes include:
    - Increase programs that support Quantum Information Science as part of SEBML (+$4.0 million to a total of $7.0 million).
    - Eliminate funding for CDI (-$1.25 million).
    - Initiate funding for programs that support CIF21 ($3.0 million), in particular a focus on the development of new computational infrastructure that supports the research portfolio in PHY.
    - Initiate funding for programs that support the SEES portfolio ($6.50 million), in particular, activities that address fundamentals in the energy/climate research base portfolio ($1.0 million) and research in science, engineering, and education for sustainability ($5.50 million)
    - Fund advanced manufacturing ($2.25 million) with a major emphasis on nanomanufacturing in the quantum realm ($1.50 million) and for manufacturing related to plasma physics ($750,000).
    - Support research at the interface between the mathematical and physical sciences and the life sciences (BioMaPS) (+$5.25 million to a total of $5.25 million). This includes emphases on research at the interface aimed at clean energy ($800,000) and advanced manufacturing ($800,000).
- CAREER funding increases by $1.83 million to a total of $7.43 million in FY 2012, reflecting a continued emphasis on fostering career development of junior scientists.
- Centers:
    - As planned, support of the 2002 STC Center for Biophotonics Science and Tech ends in FY 2011.
    - As planned, support of the NSEC: Science of Nanoscale Systems and their Device Applications will end in FY 2012, reducing the total funding for nanoscale science and engineering centers by $1.26 million to $1.14 million.
- Funding (-$4.0 million) for DUSEL-related research is redirected to the above core program areas.

Education

- GRF funding (-$1.22 million) is eliminated as the Research and Related Activities (R&RA) contribution to the program will be funded centrally through Integrative Activities (IA).

Infrastructure

- LHC: FY 2012 support for operations of the ATLAS and CMS detectors during the first period of data-taking is estimated at the current level ($18.0 million) while review and negotiations for a new cooperative agreement to begin in FY 2012 are underway.
- LIGO: Support increases (+$1.90 million to $30.40 million total) in accord with the agreed-upon funding profile for operations during the Advanced LIGO construction project. (See the MREFC chapter for more details on Advanced LIGO)
- NSCL: Support increases (+$500,000 to $21.50 million total) during negotiations for a new cooperative agreement that will sustain NSCL while design and construction for a new DOE-funded Facility for Rare Isotope Ion Beams (FRIB) facility to be built on the NSCL platform are initiated.
- IceCube: Funding increases (+$1.30 million to $3.45 million total) as part of the NSB-approved post-construction ramp-up in operations. IceCube construction is now complete, on-time and on-budget. The main IceCube detector, a massive ice-bound telescope that fills a cubic kilometer of deep Antarctic ice, contains 5,160 optical sensors on 86 strings embedded two kilometers below the Amundsen-Scott South Pole Station.
- DUSEL: NSF support for this proposed project is eliminated in FY 2012 (-$29.0 million in PHY), following the determination by the National Science Board that the scope and likely cost of the project were outside of NSF's core mission responsibilities. The $29.0 million is reallocated to frontier research grants within PHY, including core research activities in underground physics.

OFFICE OF MULTI-DISCIPLINARY ACTIVITIES (OMA) $43,410,000 +$5,080,000 / 13.3%

OMA Funding

(Dollars in Millions)

	FY 2010 Omnibus Actual	FY 2010 Enacted/ Annualized FY 2011 CR	FY 2012 Request	Change Over FY 2010 Enacted Amount	Change Over FY 2010 Enacted Percent
OMA	**$38.58**	**$38.33**	**$43.41**	**$5.08**	**13.3%**
Research	**33.52**	**34.90**	**40.21**	**5.31**	**15.2%**
Centers for Analysis and Synthesis	*0.10*	*0.10*	*0.10*	-	-
Education	**1.01**	**0.10**	**0.20**	**0.10**	**100.0%**
Pan-American Advanced Studies Institute	*0.15*	*0.10*	*0.20*	*0.10*	*100.0%*
Infrastructure	**4.05**	**3.33**	**3.00**	**-0.33**	**-9.9%**
Nat'l Nantech. Infra. Network (NNIN)	*0.33*	*0.33*	-	*-0.33*	*-100.0%*
Pre-construction planning (total)	*3.72*	*3.00*	-	*-3.00*	*-100.0%*
Deep Underground Science & Engr. Lab (DUSEL)	*3.72*	*3.00*	-	*-3.00*	*-100.0%*

The Office of Multidisciplinary Activities (OMA) enables and facilitates MPS support of novel, challenging, or complex projects of varying scale, in both research and education, which are not readily accommodated by traditional organizational structures and procedures. This is done primarily in partnership with MPS disciplinary divisions and is especially directed at activities by multi-investigator, multidisciplinary teams, as well as cross-NSF and interagency activities.

FY 2012 Summary

All funding decreases/increases represent change over the FY 2010 Enacted level.

Research

- In FY 2012, OMA will focus on multidisciplinary research addressing the key NSF-wide priority areas of SEES, CIF21, SEBML, BioMaPS, clean energy, and advanced manufacturing.
- In the area of clean energy where MPS is partnering with BIO and ENG, OMA will coordinate across the MPS divisions and ensure full participation in Research Networks (+$2.0 million), Sustainable Energy Pathways including Matter by Design (+$3.50 million), and BioMaPS (+$2.3 million).
- In the area of advanced manufacturing, OMA will coordinate MPS' participation with BIO, CISE, and ENG in BioMaPS (+$2.30 million), industry/university partnerships (+$1.0 million), Nanomanufacturing (+$2.0 million), and Matter by Design (+$750,000).
- OMA will continue to support the National Institute for Mathematical and Biological Synthesis, a Center for Analysis and Synthesis primarily managed by BIO, at the level of $100,000 in FY 2012.

Education

- Funding will double for the Pan-American Advanced Studies Institutes (+$100,000 to $200,000) to increase the base award size for this program.

Facilities

- NNIN: Support is reduced by $330,000 to zero. The National Nanotechnology Infrastructure Network continues to be an important asset to its user community. The reduction of OMA support reflects the maturing status of this investment.

- DUSEL: NSF support for this proposed project is eliminated in FY 2012 (-$3.0 million in OMA), following the determination by the National Science Board that the scope and likely cost of the project were outside of NSF's core mission responsibilities.